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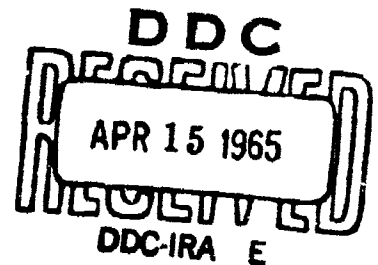
FINAL REPORT
to the
Office of Naval Research
on
Contract SAR/Nonr 609 (08) - NR 101-320

NEUROLOGICAL MECHANISMS IN EPILEPSY AND BEHAVIOR

By

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March, 1965

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The scientific investigations supported by contract SAR / Nonr 609 (08) were carried out from November 1st, 1953 until October 31st, 1963 with an annual rate of \$7,950. - \$10,000. The title of the project "Neurological mechanisms in epilepsy and behavior" was representative of the main aims of the research.

I would like to emphasize that the economic support was at a modest level, but it represented a decisive help to develop a new methodology for the study of brain functions by means of permanent implantation of electrodes and chemitrodes, radio-stimulation, time lapse photography and telemetry. Some of these methods have been used by different investigators in the U.S.A. and in several foreign countries. Clinical applications have already derived from our studies, using long term implantation of electrodes in the human brain as a diagnostic and therapeutic device. Our investigations, carried out mainly in monkeys, showed, among other facts, that learning may be induced by direct stimulation of the brain; initiated the study of the cerebral systems for punishment; demonstrated the possibility of controlling autonomic, somatic, behavioral and emotional reactions by stimulation of specific areas of the brain in awake animals; proved that hierarchy, sexual activity, aggressiveness and other social relations may be modified by intracerebral excitation; and in human patients it was shown that pleasure, friendliness, fear, hostility moods, verbal output and other mental activities may be evoked or modified by electrical stimulation of the central nervous system. These findings advance the new understanding of the mind and mental functions as being not only the subjects of philosophical speculation but also objects for scientific neurophysiological investigation.

Particularly rewarding was the collaboration - made possible through our support by ONR - with Dr. Schaefer and his group at the U.S. Naval Research Laboratories at the Submarine Base in New London, to study in a joint project the effects of CO₂ upon different cerebral functions; and the collaboration with Dr. Tamas and his group at the Aerospace Medical Research Laboratories of the Wright-Patterson Air Force Base in Ohio, to study, also as a joint project, the effects on the central nervous system of some of the high energy fuels used to propel rockets.

The ONR support has made possible another research project carried out in collaboration with the Cajal Institute in Madrid, Spain, for the histological study of cerebral structures after long term stimulation and for the preparation of a functional atlas of the brain, in which histological and stereotaxic data will be correlated with local electrical activity - spontaneous and induced - and with autonomic, somatic and behavioral effects evoked by electrical stimulation of the brain.

The results of our investigation have been explained in the annual reports submitted to the ONR, as listed in the following pages, and have appeared in more detail in the published papers which are listed in this final report. Reprints of these papers have been sent regularly to the Physiology Branch Offices of Naval Research.

Collaborators in Research supported by Contract SAR/Nonr 609 (08)

Alonso de Florida, Francisco, M.D.	Livingston, Robert B., M.D.
Apelbaum, José, M.D.	Looney, Edmund, Research Assistant
Ashworth, D., M.D.	Mahl, George F., Ph.D.
Back, Kenneth C., M.D.	Mihailović, Ljubodrag, M.D.
Boyden, Douglas, M.D.	Miller, Neal E., Ph.D.
Brazier, Mary A.B., Ph.D.	Nahum, L.H., M.D.
Bucaille, Maurice, M.D.	Poindexter, E. Roy, Research Assistant
Bursten, Ben, M.D.	Roberts, Warren W., Ph.D.
Candelas, R.R., M.D.	Rodriguez Delgado, Rafael, LL.D.
Carey, Charles R., Research Assistant	Rodriguez Pérez, A.P., M.D.
Castejon, Francisco J., M.D.	Rosvold, H. Enger, Ph.D.
Chapman, William P., M.D.	Rubinstein, Eduardo H., M.D.
Cross, Harold D., M.D.	Sanabra, F.R., M.D.
Delgado, Caroline S., Research Assistant	Santisteban, Francisco, M.D.
de los Santos, M.A., M.D.	Schaefer, K.E., M.D.
Fonberg, Elzbieta, M.D.	Schoolman, Arnold, Ph.D., M.D.
Garotte, Lionel, M.D.	Sevillano, Manuel, M.D.
Hamlin, Hannibal, M.D.	Simhadri, Pillarisetti, M.D.
Higgins, John W., M.D.	Spiro, Howard M., M.D.
Hofmann, Helmut, M.D.	Symmes, David, Ph.D.
Hollowell, O. Weems, M.D.	Tamas, Anton A., M.D.
Koskoff, Yale David, M.D.	Ushiyama, Junji, M.D.

Our research, together with the specialized methods involved, constituted a teaching program for medical, graduate, and post-graduate students. In addition, these studies have been the basis for inter-departmental collaboration with the Departments of Psychology (Dr. Neal Miller), Pharmacology (Dr. E. Canellakis and Dr. N. Giarman), Gastroenterology (Dr. H. Spiro and Dr. W. Thayer, Jr.), Physical Medicine (Dr. Ian MacLean), Anesthesiology (Dr. L. Kitahata), and Neurology (Dr. J. Prichard).

Prof. Dr. Felix G. Sulman, Head of the Department of Applied Pharmacology, The Hebrew University, Jerusalem, Israel, came for a two months' period in September and October, 1964, to learn methods of intracerebral perfusion.

In previous years, investigators from England, France, Germany, Yugoslavia, Spain, India, Poland, Japan, Mexico, and Argentina have come to my laboratory as fellows, supported, usually, by their respective countries.

Some diagnostic and therapeutical applications have resulted from our past research. The type of intracerebral electrodes developed in this laboratory have been used by several neurosurgeons. Among others, we have supplied them to:

Dr. John Adams, San Francisco Medical Center, San Francisco, Cal.
Dr. Martin Adler, Albert Einstein College of Medicine, New York
Dr. L. V. Amador, Univ. Chicago School of Medicine, Chicago, Ill.
Dr. Watson Albert, Mount Zion Hospital, San Francisco, Cal.
Dr. Irving Cooper, St. Barnabas Hospital, New York, N. Y.
Dr. Hannibal Hamlin, Howard State Hospital, Providence, R. I.
Dr. Frederich Haugen, Univ. Oregon Medical School, Portland, Ore.
Dr. Henry Lesse, Tulane University, New Orleans, La.
Dr. Ernest Sachs, Hitchcock Clinic, Hanover, N. H.
Dr. William Sweet, Mass. General Hospital, Boston, Mass.
Dr. Simon Thiry, Clinique Neurochirurgicale, Univ. de Liège, Belgium
Medicinalco: Danish Medical Research Company, Copenhagen, Denmark

Index of all technical reports issued under Contract SAR / Nonr 609 (08):

1. January, 1953. Proposal for Contract.
2. January 15, 1954. Annual Progress Report: Abstract of Results.
November 1, - December 31, 1953.
3. July 1, 1954. Progress Report and Proposal for Renewal of Contract.
Nov. 1, 1953 - July 1, 1954.
4. December 22, 1954. Annual Progress Report: Abstract of Results.
Jan. 15 - Dec. 20, 1954.
5. January 20, 1955. Annual Progress Report.
January, 1954 - January, 1955.
6. July 1, 1955. Progress Report and Proposal for Renewal of Contract.
Nov. 1, 1954 - July 1, 1955.
7. December 29, 1955. Annual Progress Report: Abstract of Results.
Jan. 1 - Dec. 20, 1955.
8. January 30, 1956. Annual Progress Report and Proposal for Renewal of Contract.
Jan. 1, 1955 - Jan. 1, 1956.
9. December 1, 1956. Annual Progress Report: Abstract of Results.
Jan. 1 - Dec. 1, 1956.
10. January 30, 1957. Annual Progress Report and Proposal for Renewal of Contract.
Jan. 1, 1956 - Jan. 1, 1957.
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Jan. 1, 1957 - Nov. 15, 1957.
12. November 15, 1958. Annual Progress Report: Abstract of Results.
Nov. 15, 1957 - Nov. 15, 1958.
13. November 13, 1959. Annual Progress Report: Abstract of Results.
November, 1958 - November, 1959.
14. January 10, 1960. Annual Progress Report and Proposal for Renewal of Contract.
Dec. 31, 1958 - Dec. 31, 1959.
15. April 20, 1960. Annual Progress Report.
Jan. 10, 1960 - April 15, 1960.

16. November 1, 1960. Progress Report: January - November, 1960.
17. April 20, 1961. Annual Progress Report.
April 15, 1960 - April 15, 1961.
18. November 1, 1961. Annual Progress Report: Abstract of Results.
Jan. 1, 1961 - November 1, 1961.
19. April 17, 1962. Annual Progress Report.
April 15, 1961 - April 15, 1962.
20. November 1, 1962. Annual Progress Report: Abstract of Results.
Jan. 1, 1962 - Nov. 1, 1962.
21. January 1, 1963. Annual Progress and Proposal for Renewal of Contract.
April 15, 1962 - December 31, 1962.
22. November 15, 1963. Annual Progress Report: Abstract of Results.
Jan. 1, 1963 - Nov. 15, 1963.
23. April 2, 1964. Progress Report on Leave of Absence.
July 1, 1963 - March 31, 1964.
24. April 15, 1964. Annual Progress Report.
Jan. 1, 1963 - April 15, 1964.

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